ECE 3050 Analog Electronics Quiz 8

October 14, 2009

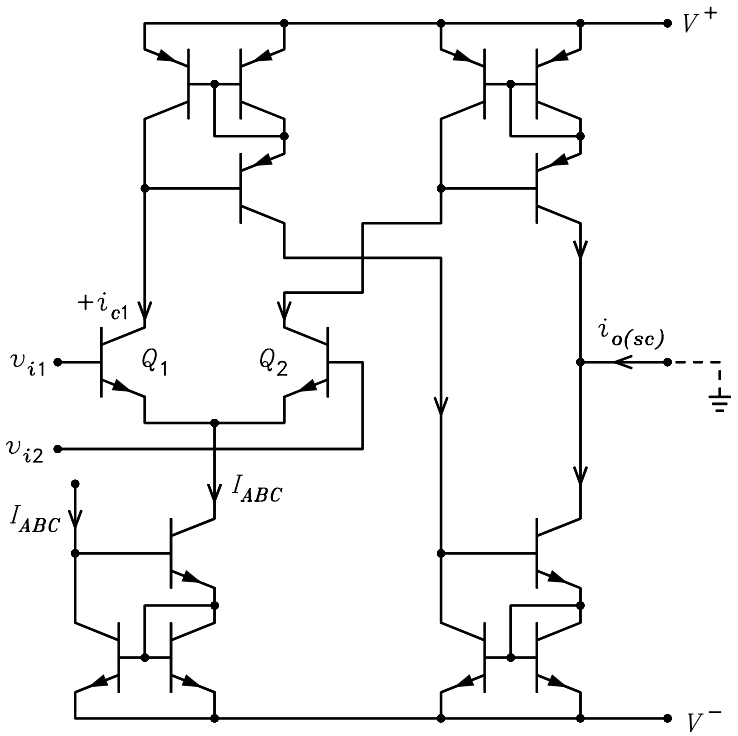
Professor Leach Name_____

Instructions. Print your name in the space above. Place a box around your answers. Points will be subtracted if you do not express each numerical answer as a decimal number and if you do not put a box around answers. **Honor Code Statement:** *I have neither given nor received help on this quiz.* Initials _____

1. (a) Draw the circuit diagram of an npn Wilson current mirror and explain its principle advantage over the other current mirrors. – The circuit diagram is in the class notes. The advantage is that it has a higher output resistance and, therefore, looks more like an ideal current source.
   (b) In typical applications, why must a two resistor voltage divider be connected between a signal source and the input terminal to a transconductance op amp? – The input diff amp overloads at about 50 mV. When applying signals greater than this value, the input must be attenuated with a voltage divider.
   (c) How is the gain of the transconductance op amp, i.e. current output divided by voltage input, varied in a circuit? – By varying the current I_{ABC}.
   (d) Draw an op amp circuit that can be used to convert the current output of the transconductance op amp into a voltage while presenting a virtual ground load on the transconductance op amp. Give the equation for the voltage output of the circuit as a function of the current output of the transconductance op amp. – This is in the class notes.

2. (a) Assume all current mirrors are perfect and neglect the Early effect. Adjacent to all unlabeled current arrows, label the current in terms of i_{c1} and solve for $i_{o(sc)}$ in terms of i_{c1}. – This is in the class notes. In addition, the notes give the dc currents in terms of I_{ABC}. It was optional on the quiz to include them because they cancel at $i_{o(sc)}$.
   (b) If the Early effect is neglected, what is $i_{o(sc)}$ in terms of v_{i1} and v_{i2}?

$$i_{o(sc)} = \frac{v_{i1} - v_{i2}}{2r_e} \overset{\text{or}}{=} \frac{g_m}{2}\left(v_{i1} - v_{i2}\right) \qquad r_e = \frac{2V_T}{I_{ABC}} \qquad g_m = \frac{I_{ABC}}{2V_T}$$


V^+
$+i_{c1}$
$i_{o(sc)}$
v_{i1}
Q_1
Q_2
v_{i2}
I_{ABC}
I_{ABC}
V^-